Variation of Facial Soft Tissue Thickness in Nepalese Adult Orthodontic Subjects

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ABSTRACT

Introduction: Variations in facial soft tissue thickness have been established previously by studies conducted in different population. Hence, it is essential to obtain facial soft tissue thickness measurement data specific to a population and develop individual standards. The objective of this research is to obtain facial soft tissue thickness data of Nepalese adult male and female subjects seeking orthodontic treatment with different sagittal skeletal malocclusion and evaluate variations in facial soft tissue thickness.

Materials & Method: Facial soft tissue thicknesses was measured manually on ninety pretreatment lateral cephalogram at eleven points (Glabella, Nasion, Rhinion, Subnasale, Labrale superius, Stomion, Labrale inferius, Labiomentale, Pogonion,Gnathion and Menton). One-way Analysis of variances [one-way ANOVA] followed by Least significant difference (LSD) post hoc test was used to determine difference in facial soft tissue thickness measurements among three sagittal skeletal group for both sexes. In addition, Student's t-test was used to find difference in facial soft tissue thickness between the male and female subjects in each skeletal Class.

Result: Statistically significant differences were found at points Rhinion, Subnasale, Labrale superius, Stomion and Gnathion in males and at Subnasale, Labrale superius, Stomion and Labrale inferius in females while comparing facial soft tissue thickness among three sagittal skeletal classes. Also, it was observed that mean facial soft tissue thickness was greater for males as compared to female subjects with significant differences at Subnasale, Labrale superius, and Labrale inferius in each skeletal Class.

Conclusion: Facial soft tissue thickness varies considerably among different population group, sex and sagittal relationship of jaws.

Keywords: Facial soft tissue thickness, Nepalese adult population, Sagittal skeletal malocclusion

INTRODUCTION

Since the Angle era, the aim and objectives of orthodontic treatment is to achieve a harmonious skeletal, dental and soft tissue relationship. However, in recent years there has been a change in treatment goals. A harmonious and balanced face (having normal soft tissue proportion and adaptation) with optimal functional occlusion are the primary and secondary goals of contemporary orthodontic and orthognathic treatment respectively. Considering this new "Soft Tissue Paradigm", an increased emphasis is given on soft tissue evaluation during diagnosis and treatment planning of patients requiring orthodontic treatment and/or orthognathic surgeries.[1] Over the years, various studies have been carried out to evaluate facial soft tissue and establish soft tissue norms for individual population.[2-6] Most of these studies have found racial/ethnic variations and sexual dimorphism for facial soft tissue thickness. Also, a difference in facial soft tissue thickness among different sagittal skeletal malocclusion has been observed in previous studies.[7-12] Hence, availability of a population specific measurement data for facial soft tissue thickness can be very useful.

However, based on our electronic literature search using key words "facial soft tissue thickness", "skeletal malocclusion" and "Nepalese population" we could not find any published study evaluating facial soft tissue thickness and its variation. Hence, the present study was undertaken to obtain facial soft tissue thickness of Nepalese adult male and female subjects seeking orthodontic treatment at a tertiary level hospital in Central Nepal, study sexual dimorphism and evaluate

variation in facial soft tissue thickness among different sagittal skeletal malocclusion.

MATERIALS AND METHOD

Ethical approval for the study was obtained from Institutional Review Committee, Kathmandu University School of Medical Sciences (IRC no- 93/18). A total of 90 pretreatment lateral cephalograms of adult male and female subjects between 18 to 25 years with different sagittal skeletal malocclusion [Skeletal Class I: 30(Male-15; Female-15), Skeletal Class II: 30(Male-15; Female-15), Skeletal Class III: 30(Male-15; Female-15)] visiting Department of Orthodontics, were selected from cephalometric database according to following criteria:

Inclusion Criteria:

- Good quality cephalograms of healthy Nepalese subjects with normal growth pattern (SN-MP=32±5 degree), having lips in relaxed position with Frankfort plane parallel to horizontal, teeth in centric occlusion and ANB angle
- For skeletal Class I group: ANB angle (0-4 degree)
- For skeletal Class II group:ANB angle (> 4 degree)
- For skeletal Class III group: ANB angle (< 0 degree)

Exclusion Criteria:

- Cephalograms of patients having any known genetic/craniofacial abnormalities, growth related disorders, with history of facial trauma and or who had undergone orthodontic treatment/craniofacial surgery
- Cephalograms of patients with positional errors as reflected by ear rod markers.
- Cephalograms in which landmarks could not be identified because of artifacts, motion, resolution disparity or lack of contrast.

All the cephalograms acquired were taken from the same digital cephalometer (PlanmecaPromax, PlanmecaOy, Helsinki, Finland) and had the calibration ruler for determination of magnification. X-ray images were printed on 8''X10'' radiographic film using compatible printer (Drypro Sigma 2, Konica Minolta, Tokyo, Japan) and manual tracing was done using standard protocols. Calibration of the actual size of each image in millimeters was done based on measurement of the known distance (10 mm) between the two fixed points of the ruler on the cephalogram. Using a millimeter ruler the facial soft tissues thickness were measured to the nearest 0.5 mm at 11 points: Glabella, Nasion, Rhinion, Subnasale, Labrale superius, Stomion, Labrale inferius,

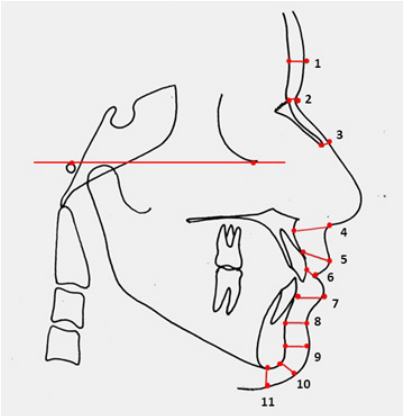

Figure 1: The measurement points used in the study- 1.Glabella, 2.Nasion, 3.Rhinion, 4.Subnasale, 5.Labrale superius, 6.Stomion, 7.Labrale inferius, 8.Labiomentale, 9.Pogonion,10.Gnathion and11.Menton. Points 1,2,3,9,10 and 11 will be perpendicular to FHP or to bony surfaces. While point 4, the distance between Point A and Subnasaale; 5, the distance between Prosthion/Supradentale and .Labralesuperius; 6, the shortest distance between the upper incisor and Stomion; 7, the distance between Infradentale and Labraleinferius; 8, the distance between Point b and the deepest point of the labiomental crease.

Labiomentale, Pogonion, Gnathion and Menton (Figure 1). After adding magnification factor to the obtained linear measurements final values were recorded and were entered into an Excel spreadsheet. To avoid intra-observer bias all the assessments (tracing as well as measurement) were done by a same investigator (RKM).

Also, only five cephalograms were analyzed daily to minimize errors due to the human fatigue. To evaluate the errors due to landmark identification, tracing and measurement 15 cephalograms were randomly selected. After three weeks gap, all the landmarks were replotted. Manual tracing and measurements were repeated on these cephalograms.

All the statistical analyses were carried out using the Statistical Package for Social Sciences version 16.0 (SPSS Inc,Chicago, IL). Intraclass correlation coefficient (ICC) was done to determine intra-observer reliability and reproducibility for repeated measurements. Normality of data distribution was checked using Shapiro-Wilk test. Mean, standard deviation and standard error mean values were calculated for facial soft tissue thickness at eleven different points measured in the study. One-way Analysis of variances [one-way ANOVA] was used for analyzing difference in mean facial soft tissue thickness among three sagittal skeletal groupsat each point.When a significant difference was observed, Least significant difference (LSD) post hoc testwas used to find out individual difference.In addition to these tests, Student's

t-test was used to find out difference in mean facial soft tissue thickness between the male and female subjects in each sagittal skeletal groupat each point. The level of significance was noted at three levels (*p < 0.05); (**p < 0.01); (***p < 0.001).

RESULT

ICC values were more than 0.9 for repeated cephalometric measurements. This is suggestive of a very high intra-observer reliability and reproducibility as ICC value of > 0.75 is indicative of a good agreement. The mean age of subjects was (20.57 ± 1.95) years. For Class I it was (20.70 ± 1.78) years, for Class II (20.63 ± 1.90) years and for Class III (20.40 ± 2.20) years. Similarly, mean age for male subjects was (20.51 ± 2.01) years and for female subjects was (20.64 ± 1.90) years. Gender wise mean age for each sagittal skeletal group are shown in (Table 1).

Table 2 and 3 show mean facial soft tissue thickness, standard deviation, standard error and comparison

Table 1: Gender wise mean age of subjects in each sagittal skeletal group

Group	Gender	N	Mean age (Years)	SD
Class I	Male	15	20.26	1.75
	Female	15	21.13	1.76
Class II	Male	15	20.46	1.84
	Female	15	20.80	2.00
Class III	Male	15	20.80	2.48
	Female	15	20.00	1.88

Table 2:Comparison of facial soft tissue thickness among three skeletal classes at different points measured for the male subjects

Points	Group	N	Mean	SD	SEM	P value†	CL I-CL II‡	CL I-CL III‡	CL II-CL III‡
Glabella (G)	Class I	15	5.80	0.55	0.14	NS	NS	NS	NS
	Class II	15	5.48	0.90	0.23				
	Class III	15	6.15	0.79	0.20				
Nasion (N)	Class I	15	6.00	1.05	0.27	NS	NS	NS	NS
	Class II	15	6.39	1.06	0.27				
	Class III	15	6.70	1.62	0.42				
Rhinion (Rhi)	Class I	15	2.90	0.73	0.18	*	NS	NS	**
	Class II	15	2.48	0.52	0.13				
	Class III	15	3.39	1.47	0.38				
Subnasale (Sn)	Class I	15	17.06	1.84	0.47	**	*	NS	**
	Class II	15	15.54	1.64	0.42				
	Class III	15	17.92	1.95	0.50				
Labralesuperius (Ls)	Class I	15	15.48	1.11	0.28	***	***	**	***
	Class II	15	13.57	1.20	0.31				
	Class III	15	17.81	2.55	0.66				
Stomion (Sto)	Class I	15	6.45	1.69	0.43	***	***	***	***
	Class II	15	3.61	1.33	0.34				
	Class III	15	12.38	3.10	0.80				
Labraleinferius (Li)	Class I	15	15.12	1.21	0.31	NS	NS	NS	NS
	Class II	15	15.67	1.36	0.35				
	Class III	15	14.65	1.42	0.36				
Labiomentale (Labm)	Class I	15	11.65	1.15	0.29	NS	NS	NS	NS
	Class II	15	11.59	1.70	0.44				
	Class III	15	11.79	1.73	0.44				
Pogonion (Pog)	Class I	15	10.60	1.59	0.41	NS	NS	NS	NS
	Class II	15	10.25	1.97	0.51				
	Class III	15	10.31	1.78	0.46				
Gnathion (Gn)	Class I	15	8.87	1.92	0.49	*	**	NS	NS
	Class II	15	7.15	1.39	0.36				
	Class III	15	8.18	1.71	0.44				
Menton (Me)	Class I	15	7.26	1.87	0.48	NS	NS	NS	NS
	Class II	15	6.10	1.60	0.41				
	Class III	15	7.13	1.53	0.39				

*SD, Standard deviation; SEM, standard error mean; CL I ,Class I; CL II,Class II; CL III,Class III; NS, not significant. *p < 0.05; **p < 0.01; ***p < 0.001. ; †ANOVA (one-way analysis of variance); ‡ LSD(least significant difference)*

Table 3:Comparison of facial soft tissue thickness among three skeletal classes at different points measured for the female subjects

Points	Group	N	Mean	SD	SEM	P value†	CL I-CL II‡	CL I-CL III‡	CL II-CL III‡
Glabella (G)	Class I	15	5.39	1.18	0.30	NS	NS	NS	NS
	Class II	15	5.40	0.80	0.20				
	Class III	15	5.56	0.77	0.20				
Nasion (N)	Class I	15	5.56	1.15	0.29	NS	NS	NS	NS
	Class II	15	5.48	0.80	0.20				
	Class III	15	5.16	0.75	0.19				
Rhinion (Rhi)	Class I	15	2.30	0.61	0.15	NS	NS	NS	NS
	Class II	15	2.33	0.91	0.23				
	Class III	15	2.42	0.51	0.13				
Subnasale (Sn)	Class I	15	14.06	1.43	0.36	*	NS	NS	**
	Class II	15	13.22	1.16	0.30				
	Class III	15	14.88	2.16	0.55				
Labralesuperius (Ls)	Class I	15	12.47	1.34	0.34	**	*	NS	**
	Class II	15	11.25	1.09	0.28				
	Class III	15	13.55	2.13	0.55				
Stomion (Sto)	Class I	15	6.00	1.78	0.46	***	***	**	***
	Class II	15	3.18	1.17	0.30				
	Class III	15	8.23	1.96	0.50				
Labraleinferius (Li)	Class I	15	13.28	1.14	0.29	*	NS	NS	*
	Class II	15	13.83	1.38	0.35				
	Class III	15	12.18	1.70	0.44				
Labiomentale (Labm)	Class I	15	10.45	0.90	0.23	NS	NS	NS	NS
	Class II	15	10.36	1.24	0.32				
	Class III	15	11.25	2.25	0.58				
Pogonion (Pog)	Class I	15	9.69	1.42	0.36	NS	NS	NS	NS
	Class II	15	9.88	1.85	0.47				
	Class III	15	9.49	2.26	0.58				
Gnathion (Gn)	Class I	15	8.23	2.13	0.55	NS	NS	NS	NS
	Class II	15	7.74	2.00	0.51				
	Class III	15	7.40	2.16	0.56				
Menton (Me)	Class I	15	6.45	1.38	0.35	NS	NS	NS	NS
	Class II	15	6.33	1.29	0.33				
	Class III	15	6.23	2.35	0.60				

*SD, Standard deviation; SEM, standard error mean; CL I ,Class I; CL II,Class II; CL III,Class III; NS, not significant. *p < 0.05; **p < 0.01; ***p < 0.001. ; †ANOVA (one-way analysis of variance); ‡LSD(least significant difference)*

of facial soft tissue thickness among three skeletal classes at each point measured for the male and female samples respectively. A significant difference were found at Rhinion between Class II and III ($p < 0.01$); Subnasale between Class I and II ($p < 0.05$) and between Class II and III ($p < 0.01$); Labrale superius between Class I and II ($p < 0.001$), between Class I and III ($p < 0.01$) and between Class II and III($p < 0.001$); Stomion between Class I and II ($p < 0.001$), between Class I and III ($p < 0.001$) and between Class II and III($p < 0.001$) and Gnathion between Class I and II($p < 0.01$) in males and at Subnasale between Class II and III($p < 0.01$); Labrale superius between Class I and II ($p < 0.05$) and between Class II and III ($p < 0.01$); Stomion between Class I and II ($p < 0.001$) , between Class I and III ($p < 0.01$) and between Class II and III ($p < 0.001$) and Labrale inferius between Class II and III ($p < 0.05$) in females.

Table 4 shows comparison of facial soft tissue thickness between male and female subjects in each sagittal skeletal group at different points measured in the study. Mean facial soft tissue thickness was found to be greater for males as compared to female subjects at all the points. However, statistically significant difference were observed at points Rhinion, Subnasale, Labrale superius ,Labrale inferius and Labiomentale in skeletal Class I. In skeletal class II difference were found at Nasion,Subnasale, Labrale superius, Labrale inferius. While, in skeletal class III difference were observed at Glabella, Nasion, Rhinion, Subnasale, Labrale superius, Stomion and Labrale inferius.

Table 4: Comparison of facial soft tissue thickness between male and female subjects in each sagittal skeletal group at different points measured in the study

Points	Group	Gender	N	Mean	SD	SEM	P value†
Glabella (G)	Class I	Male	15	5.80	0.55	0.14	NS
		Female	15	5.39	1.18	0.30	
	Class II	Male	15	5.48	0.90	0.23	NS
		Female	15	5.40	0.80	0.20	
	Class III	Male	15	6.15	0.79	0.20	*
		Female	15	5.56	0.77	0.20	
Nasion (N)	Class I	Male	15	6.00	1.05	0.27	NS
		Female	15	5.56	1.15	0.29	
	Class II	Male	15	6.39	1.06	0.27	*
		Female	15	5.48	0.80	0.20	
	Class III	Male	15	6.70	1.62	0.42	**
		Female	15	5.16	0.75	0.19	
Rhinion (Rhi)	Class I	Male	15	2.90	0.73	0.18	*
		Female	15	2.30	0.61	0.15	
	Class II	Male	15	2.48	0.52	0.13	NS
		Female	15	2.33	0.91	0.23	
	Class III	Male	15	3.39	1.47	0.38	**
		Female	15	2.42	0.51	0.13	
Subnasale (Sn)	Class I	Male	15	17.06	1.84	0.47	***
		Female	15	14.06	1.43	0.36	
	Class II	Male	15	15.54	1.64	0.42	***
		Female	15	13.22	1.16	0.30	
	Class III	Male	15	17.92	1.95	0.50	***
		Female	15	14.88	2.16	0.55	
Labralesuperius (Ls)	Class I	Male	15	15.48	1.11	0.28	***
		Female	15	12.47	1.34	0.34	
	Class II	Male	15	13.57	1.20	0.31	***
		Female	15	11.25	1.09	0.28	
	Class III	Male	15	17.81	2.55	0.66	***
		Female	15	13.55	2.13	0.55	
Stomion (Sto)	Class I	Male	15	6.45	1.69	0.43	NS
		Female	15	6.00	1.78	0.46	
	Class II	Male	15	3.61	1.33	0.34	NS
		Female	15	3.18	1.17	0.30	
	Class III	Male	15	12.38	3.10	0.80	**
		Female	15	8.23	1.96	0.50	
Labraleinferius (Li)	Class I	Male	15	15.12	1.21	0.31	***
		Female	15	13.28	1.14	0.29	
	Class II	Male	15	15.67	1.36	0.35	**
		Female	15	13.83	1.38	0.35	
	Class III	Male	15	14.65	1.42	0.36	***
		Female	15	12.18	1.70	0.44	
Labiomentale (Labm)	Class I	Male	15	11.65	1.15	0.29	**
		Female	15	10.45	0.90	0.23	
	Class II	Male	15	11.59	1.70	0.44	NS
		Female	15	10.36	1.24	0.32	
	Class III	Male	15	11.79	1.73	0.44	NS
		Female	15	11.25	2.25	0.58	
Pogonion (Pog)	Class I	Male	15	10.60	1.59	0.41	NS
		Female	15	9.69	1.42	0.36	
	Class II	Male	15	10.25	1.97	0.51	NS
		Female	15	9.88	1.85	0.47	
	Class III	Male	15	10.31	1.78	0.46	NS
		Female	15	9.49	2.26	0.58	
Gnathion (Gn)	Class I	Male	15	8.87	1.92	0.49	NS
		Female	15	8.23	2.13	0.55	
	Class II	Male	15	7.15	1.39	0.36	NS
		Female	15	7.74	2.00	0.51	
	Class III	Male	15	8.18	1.71	0.44	NS
		Female	15	7.40	2.16	0.56	
Menton (Me)	Class I	Male	15	7.26	1.87	0.48	NS
		Female	15	6.45	1.38	0.35	
	Class II	Male	15	6.10	1.60	0.41	NS
		Female	15	6.33	1.29	0.33	
	Class III	Male	15	7.13	1.53	0.39	NS
		Female	15	6.23	2.35	0.60	

*SD, Standard deviation; SEM, standard error mean; Sig., significant; NS, not significant.*p < 0.05; **p < 0.01; ***p < 0.001. ; †Student's t-test*

DISCUSSION

Measurement of facial soft tissue thickness has become an integral part of diagnosis and treatment planning in contemporary orthodontics and for patients requiring orthognathic surgeries for various craniofacial deformities. A considerable variation in facial soft tissue thickness has been observed among different population groups, sex and sagittal skeletal malocclusion in previous studies conducted in different population. Hence the present study was conducted to obtain facial soft tissue thickness data of Nepalese adult male and female subjects seeking orthodontic treatment with different sagittal skeletal malocclusion and evaluate variations in facial soft tissue thickness among Nepalese adults.

In this study, we measured facial soft tissue thickness of adult male and female subjects with three different sagittal skeletal malocclusion at 11 points i.e. Glabella, Nasion, Rhinion, Subnasale, Labrale superius, Stomion, Labrale inferius, Labiomentale, Pogonion, Gnathion and Menton. When facial soft tissue thickness was compared among three sagittal skeletal classes, we found significant differences at points Rhinion, Subnasale, Labrale superius and Stomion in males and at Subnasale, Labrale superius, Stomion and Labrale inferius in females.

Kurkcuoglua *et al*[7] conducted a study in healthy adult Turkish population and found a significant difference at Nasion, Subnasale, Labrale superius, Stomion, Labrale inferius and Menton in males and at Labrale superius, Labrale inferius and Pogonion in females. On the other hand, Kamak and Celikoglu[8] found a significant difference in facial soft tissue thickness at points Labrale superius, Stomion and Labrale inferius in both Turkish males and female orthodontic patients.

However, Utsuno *et al*[9,10] in a study done in the Japanese population reported with a significant difference only at Labrale inferius in males and at Subnasale, Labrale superius, Stomion, Labiomentale and Pogonion in females.

In a similar study done in the Pakistani population, Jeelani *et al*[11] found a significant difference at Glabella, Labrale superius, Stomion and Labiomentale in males and at Labrale superius, Labrale inferius, Labiomentale and Pogonion in females. While, Hamid *et al*[12] in a study conducted in the Sudanese adults found a significant difference at Nasion, Subnasale, Labrale superius, Stomion, Labrale inferius, Labiomentale and Pogonion in males and at Subnasale, Labrale superius, Stomion, Labrale inferius, Labiomentale and Pogonion in females.

The difference in the findings of these studies and ours might be due to racial/ethnic variation in soft tissue. On the other hand, when facial soft tissue thickness was compared between male and female subjects in each skeletal group, sexual dimorphism was observed with greater mean thickness for male as compared to female subjects with significant differences at Subnasale, Labrale superius, and Labrale inferius in each skeletal Class. Kamak and Celikoglu[8] and Hamid *et al*[12] also observed sexual dimorphism in facial soft tissue thickness and reported with almost similar findings. Similarly, Jeelani *et al*[11] also found a greater soft tissue thickness for men than for women in his study with significant differences at Subnasale and Labrale superius in each skeletal Class.

Apart from race/ethnicity, sagittal skeletal relationship of jaws and sex, various other factors have been found that can possibly affect the facial soft tissue thickness i.e. age, vertical growth pattern and body mass index (BMI).[13-16] Hence in the present study, mean age of the subjects were matched between the two sexes and three different sagittal skeletal malocclusion groups. Also, subjects having normal growth pattern were selected. However, we could not consider BMI of the subjects in this study because the lateral cephalogram of the subjects included in the study were taken from database of department. Hence, further studies taking BMI of the subjects into onsideration are advised.

CONCLUSION

Facial soft tissue thickness varies considerably among different population groups, sex and sagittal relationship of jaws. Availability of a population specific data can be of great help during diagnosis and treatment planning of patients requiring orthodontic treatment and/or orthognathic surgeries.

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